

CLAIMS:

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent is:

- 1 1. A method for automatically transporting a plurality of products for sequential
2 processing at one or more processing stations, one processing station comprising a
3 mechanism for determining acceptability of individual products of said plurality of
4 products conveyed thereto on one or more first transport structures, said method
5 comprising:
6
7 a) generating an information record associated with each first transport structure carrying
8 a plurality of products, said record including information for identifying products carried
9 by said first transport structure and including a data structure identifying locations of any
10 product on said transport structure determined to have met acceptability criteria as
11 determined at said one processing station;
12
13 b) conveying said first transport structure carrying zero or more acceptable products in
14 sequence to one or more downstream processing stations, and while at each processing
15 station accessing each information record and updating said associated information with
16 status of products as a result of processing thereat;
17
18 c) communicating an updated information record associated with a first transport
19 structure currently en route to a product unload area to a transport staging means for
20 staging a plurality of individual transport structures each capable of receiving an
21 individual product to be transferred from said first transport structure, said staging means
22 responsive to said data structure for aligning a plurality of individual transport structures

23 in a staging area according to locations identified in said data structure as including
24 acceptable products; and,
25 d) transferring zero or more acceptable products from identified locations in said first
26 transport structure at said product unload area to said staging area and placing a
27 corresponding individual product to an associated aligned individual transport structure,
28 wherein said updated information record associated with a first transport structure
29 currently en route to a product unload area is communicated prior to arrival of said first
30 transport structure thereat.

1 2. The method as claimed in Claim 1, wherein one of said processing stations is capable
2 of processing acceptable products from one or more transport structures conveyed
3 thereto, said method further comprising the steps of:
4
5 transferring identified acceptable products from one or more first transport structures to a
6 second transport structure for simultaneously processing at said one of said processing
7 stations; and,
8
9 generating a further information record associated with said second transport structure at
10 said processing station, including updating said data structure to identify known locations
11 of zero or more acceptable products on said second transport structure,
12
13 whereby said step c) includes communicating an updated information record associated
14 with a second transport structure currently en route to said transport staging area for
15 staging a plurality of individual transport structures each capable of receiving an
16 individual product to be transferred from said second transport structure and,
17

18 step d) includes transferring zero or more acceptable products from identified locations in
19 said second transport structure and placing a corresponding individual product to an
20 associated aligned individual transport structure.

1 3. The method as claimed in Claim 1, wherein said data structure comprises a bit pattern
2 including a pre-defined number of bits, each bit associated with a particular location on
3 said transport structure and having a first value indicating location of acceptable product
4 or, a second value indicating absence of an acceptable product.

1 4. The method as claimed in Claim 1, wherein prior to transferring step b), the step of
2 removing zero or more products from said first transport structure identified at said
3 inspection station as failing to meet said acceptable criteria in accordance with said data
4 structure.

1 5. The method as claimed in Claim 2, wherein said product is an ophthalmic lens, said
2 first transport structures for transferring formed lens products comprising a fabrication
3 tray.

1 6. The method as claimed in Claim 2, wherein said step of transferring identified
2 acceptable products from one or more first transport structures to a second transport
3 structure includes mapping the location of each zero or more acceptable product locations
4 transferred from each respective one or more transport structures providing product to the
5 second transport structure into said data structure.

1 7. The method as claimed in Claim 6, wherein said step b) of transferring one or more
2 pluralities of products from said one or more transport structures to a second transport
3 structure includes buffering a plurality of first transport structures at a buffer location
4 prior to said transfer.

1 8. The method as claimed in Claim 5, wherein said product is an ophthalmic lens, said
2 second transport structure comprising a hydration tray means for carrying acceptable lens
3 products from one or more first transport structures to a hydration station for
4 simultaneously hydrating said formed lenses.

1 9. The method as claimed in Claim 3, wherein said step of staging a plurality of
2 individual transport structures each capable of receiving an individual product to be
3 transferred from said first transport structure comprises the steps of:
4
5 feeding a plurality of individual transport structures to a first location via a first conveyor
6 in accordance with said received bit pattern;
7
8 transporting zero or more individual transport structures to said staging area via a second
9 conveyor in accordance with a received bit pattern;
10
11 one of engaging an individual transport structure in response to detection of a first bit
12 value from said bit pattern, or preventing engagement of an individual transport structure
13 in response to detection of a second bit value from said bit pattern; and respectively in
14 response,
15
16 handing-off an engaged individual transport structure to a second conveyor for indexed
17 conveyance to said staging area in accordance with a first bit value of said bit pattern or
18 is prevented from handing-off said individual transport structure to said second conveyor
19 in accordance with a second bit value of said bit pattern; and,
20
21 enabling indexed movement of said second conveyor in accordance with an amount of
22 said pre-defined number of bits in said bit pattern, whereby handed-off individual

23 transport structures are conveyed to said staging area and registered at locations
24 corresponding to received first bit values of said pre-defined number of bits.

1 10. The method as claimed in Claim 9, wherein said staging area includes a product load
2 position where said acceptable products are simultaneously transferred thereto from a
3 product unload location, said method further comprising the step of simultaneously
4 pushing said individual transport structures to said product load position after registered
5 in accordance with said bit pattern.

1 11. A system for automatically transporting a plurality of ophthalmic lens for sequential
2 processing at one or more processing stations, one processing station comprising a
3 mechanism for determining acceptability of individual products of said plurality of
4 products conveyed thereto on one or more first transport structures and generating an
5 information record associated with each first transport structure including information for
6 identifying products carried by said first transport structure and including a data structure
7 identifying locations of any product on said first transport structure determined to have
8 met acceptability criteria as determined at said one processing station, said system
9 comprising:

10
11 communications infrastructure for enabling access to said information records at each
12 downstream processing station in coordination with processing of products carried by its
13 associated first transport structure at a respective processing station;

14
15 a transport staging means for staging a plurality of individual transport structures each
16 capable of receiving an individual product to be transferred from said first transport
17 structure in response to a received information record associated with a first transport
18 structure currently en route to a product unload area, said staging means including means

19 for aligning zero or more individual transport structures in a staging area according to
20 locations identified in said data structure as including acceptable products; and,
21
22 a first transfer mechanism including transfer elements for transferring zero or more
23 acceptable products from said first transport structure to respective individual aligned
24 transport structures in said staging area; and,
25
26 control means responsive to receipt of said information records associated with one or
27 more first transport structures for coordinating activation of said transfer elements at
28 locations of acceptable products to be transferred by said first transfer mechanism as
29 indicated by said data structure, and initiating simultaneous transfer and placement of
30 individual products to a respective aligned transport structure, wherein said information
31 record associated with a first transport structure currently en route to a product unload
32 area is communicated prior to arrival of said first transport structure thereat.

1 12. The system for automatically transporting products as claimed in Claim 11, wherein
2 one of said processing stations is capable of processing acceptable products from one or
3 more first transport structures conveyed thereto, said system further comprising:
4
5 second transfer mechanism for transferring identified acceptable products from one or
6 more first transport structures to a second transport structure for simultaneously
7 processing at said one of said processing stations, said control means responsive to
8 receipt of said information records associated with each respective one or more first
9 transport structures for coordinating activation of said transfer elements at locations of
10 acceptable products to be transferred by said second transfer mechanism as indicated by
11 respective data structures for each first transport structure.

1 16. The system for automatically transporting products as claimed in Claim 12, wherein
2 said product is an ophthalmic lens, said first transport structures for transporting formed
3 lens products comprising a fabrication tray.

1 19. The system for automatically transporting products as claimed in Claim 14, wherein
2 said staging mechanism includes:
3
4 a first conveyor mechanism for feeding a plurality of individual transport structures to a
5 first location in accordance with said received bit pattern;
6
7 a second conveyor mechanism for transporting zero or more individual transport
8 structures to said staging area in accordance with a received bit pattern;
9
0 device located at said first location for engaging an individual transport structure in
1 response to detection of a first bit value from said bit pattern, or preventing engagement
2 of an individual transport structure in response to detection of a second bit value from
3 said bit pattern, said device either handing-off an engaged individual transport structure
4 to said second conveyor for indexed conveyance to said staging area in accordance with a
5 first bit value of said bit pattern or is prevented from handing-off said individual transport

7 a) generating an information record associated with each first transport structure carrying
8 a plurality of lenses, said record including information for identifying the lenses carried

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24. The method for automatically transporting a plurality of ophthalmic lenses as claimed in Claim 22, wherein said data structure comprises a bit pattern including a pre-defined number of bits, each bit associated with a particular location on said first transport structure and having a first value indicating location of an acceptable lens or, a second value indicating absence of an acceptable lens.

VTN-552

1 26. The method for automatically transporting a plurality of ophthalmic lenses as claimed
2 in Claim 23, wherein said first transport structure comprises a fabrication tray having lens
3 products formed therein.

1 27. The method for automatically transporting a plurality of ophthalmic lenses as claimed
2 in Claim 23, wherein said step of transferring identified acceptable lenses from one or
3 more first transport structures to a second transport structure includes mapping the
4 location of each zero or more acceptable lens locations transferred from each respective
5 one or more transport structures providing lenses to the second transport structure into
6 said data structure.

1 28. The method for automatically transporting a plurality of ophthalmic lenses as claimed
2 in Claim 27, wherein said step b) of transferring one or more pluralities of lenses from
3 said one or more transport structures to a second transport structure includes buffering a
4 plurality of first transport structures at a buffer location prior to said transfer.

1 29. The method for automatically transporting a plurality of ophthalmic lenses as claimed
2 in Claim 26, wherein said second transport structure comprises a hydration tray means for
3 carrying acceptable lens products from said one or more first transport structures to a
4 hydration station for simultaneously hydrating said formed lenses.

1 30. The method for automatically transporting a plurality of ophthalmic lenses as claimed
2 in Claim 24, wherein said step of staging a plurality of individual transport structures
3 each capable of receiving an individual lens to be transferred from said first transport
4 structure comprises the steps of:

5
6 feeding a plurality of individual transport structures to a first location via a first conveyor
7 in accordance with said received bit pattern;

8 transporting zero or more individual transport structures to said staging area via a second
9 conveyor in accordance with a received bit pattern;
10
11 one of engaging an individual transport structure in response to detection of a first bit
12 value from said bit pattern, or preventing engagement of an individual transport structure
13 in response to detection of a second bit value from said bit pattern; and respectively in
14 response,
15
16 handing-off an engaged individual transport structure to a second conveyor for indexed
17 conveyance to said staging area in accordance with a first bit value of said bit pattern or
18 is prevented from handing-off said individual transport structure to said second conveyor
19 in accordance with a second bit value of said bit pattern; and,
20
21 enabling indexed movement of said second conveyor in accordance with an amount of
22 said pre-defined number of bits in said bit pattern, whereby handed-off individual
23 transport structures are conveyed to said staging area and registered at locations
24 corresponding to received first bit values of said pre-defined number of bits.

1 31. The method for automatically transporting a plurality of ophthalmic lenses as claimed
2 in Claim 30, wherein said staging area includes a lens load position where said acceptable
3 products are simultaneously transferred thereto from a lens unload position, said method
4 further comprising the step of simultaneously pushing said individual transport structures
5 to said lens load position after registered in accordance with said bit pattern.

1 32. A system for automatically transporting a plurality of ophthalmic lens for sequential
2 processing at one or more processing stations, one processing station comprising a
3 mechanism for determining locations of acceptable lenses to be transported for further
4 downstream processing on one or more first transport structures, and generating an

information record associated with each first transport structure for identifying products carried by said first transport structure, said record including a data structure identifying said locations of any acceptable lens carried on said first transport structure, said system comprising:

communications infrastructure for enabling access to said information records at each downstream processing station in coordination with processing of lenses carried by its associated first transport structure at a respective processing station;

a transport staging means for staging a plurality of individual transport structures each capable of receiving an individual lens to be transferred from said first transport structure in response to a received information record associated with a first transport structure currently en route to a lens unload area, said staging means including means for aligning zero or more individual transport structures in a staging area according to locations identified in said data structure as including acceptable lenses;

a first transfer mechanism including transfer elements for transferring zero or more acceptable lenses from said first transport structure to respective individual aligned transport structures in said staging area; and,

control means responsive to receipt of said information records associated with one or more first transport structures for coordinating activation of said transfer elements at locations of acceptable lenses to be transferred by said first transfer mechanism as indicated by said data structure, and initiating simultaneous transfer and placement of individual lenses to a respective aligned transport structure, wherein said information record associated with a first transport structure currently en route to a lens unload area is communicated prior to arrival of said first transport structure thereat.

4 a first conveyor mechanism for feeding a plurality of individual transport structures to a
5 first location in accordance with said received bit pattern;
6
7 a second conveyor mechanism for transporting zero or more individual transport
8 structures to said staging area in accordance with a received bit pattern;
9
10 device located at said first location for engaging an individual transport structure in
11 response to detection of a first bit value from said bit pattern, or preventing engagement
12 of an individual transport structure in response to detection of a second bit value from
13 said bit pattern, said device either handing-off an engaged individual transport structure
14 to said second conveyor for indexed conveyance to said staging area in accordance with a
15 first bit value of said bit pattern or is prevented from handing-off said individual transport
16 structure to said second conveyor in accordance with a second bit value of said bit
17 pattern;
18
19 said control means enabling indexed movement of said second conveyor in accordance
20 with an amount of said pre-defined number of bits in said bit pattern, whereby handed-off
21 individual transport structures are conveyed to said staging area at a location
22 corresponding to received first bit values of said pre-defined number of bits.

1 41. The system for automatically transporting ophthalmic lenses as claimed in Claim 40,
2 wherein said staging area includes a product load position where said acceptable lenses
3 are simultaneously transferred thereto by said first transfer mechanism, said staging
4 mechanism further comprising pusher mechanism for pushing said individual transport
5 structures to said product load position according to said bit pattern.

1 42. The system for automatically transporting ophthalmic lenses as claimed in Claim 41,
2 further comprising an exit conveyor for transporting said individual transport structures

3 including a lens transferred thereto, said pusher mechanism simultaneously pushing each
4 said individual transport structure including said lens from said lens load position to said
5 exit conveyor.

1 43. A program storage device readable by a machine, tangibly embodying a program of
2 instructions executable by the machine to perform method steps for automatically
3 transporting a plurality of products for sequential processing at one or more processing
4 stations, one processing station comprising a mechanism for determining acceptability of
5 individual products of said plurality of products conveyed thereto on one or more first
6 transport structures, said method steps comprising:

7
8 a) generating an information record associated with each first transport structure carrying
9 a plurality of products, said record including information for identifying products carried
10 by said first transport structure and including a data structure identifying locations of any
11 product on said transport structure determined to have met acceptability criteria as
12 determined at said one processing station;

13
14 b) conveying said first transport structure carrying zero or more acceptable products in
15 sequence to one or more downstream processing stations, and while at each processing
16 station accessing each information record and updating said associated information with
17 status of products as a result of processing thereat;

18
19 c) communicating an updated information record associated with a first transport
20 structure currently en route to a product unload area to a transport staging means for
21 staging a plurality of individual transport structures each capable of receiving an
22 individual product to be transferred from said first transport structure, said staging means
23 responsive to said data structure for aligning a plurality of individual transport structures

44. The program storage device readable by a machine as claimed in Claim 43, wherein one of said processing stations is capable of processing acceptable products from one or more transport structures conveyed thereto, said method further comprising the steps of:

transferring identified acceptable products from one or more first transport structures to a second transport structure for simultaneously processing at said one of said processing stations; and,

generating a further information record associated with said second transport structure at said processing station, including updating said data structure to identify known locations of zero or more acceptable products on said second transport structure,

whereby said step c) includes communicating an updated information record associated with a second transport structure currently en route to said transport staging area for staging a plurality of individual transport structures each capable of receiving an individual product to be transferred from said second transport structure and,

18 step d) includes transferring zero or more acceptable products from identified locations in
19 said second transport structure and placing a corresponding individual product to an
20 associated aligned individual transport structure.

1 45. The program storage device readable by a machine as claimed in Claim 43, wherein
2 said data structure comprises a bit pattern including a pre-defined number of bits, each bit
3 associated with a particular location on said transport structure and having a first value
4 indicating location of acceptable product or, a second value indicating absence of an
5 acceptable product.

1 46. The program storage device readable by a machine as claimed in Claim 43, wherein
2 prior to transferring step b), the step of removing zero or more products from said first
3 transport structure identified at said inspection station as failing to meet said acceptable
4 criteria in accordance with said data structure.

1 47. The program storage device readable by a machine as claimed in Claim 44, wherein
2 said product is an ophthalmic lens, said first transport structures for transferring formed
3 lens products comprising a fabrication tray.

1 48. The program storage device readable by a machine as claimed in Claim 44, wherein
2 said step of transferring identified acceptable products from one or more first transport
3 structures to a second transport structure includes mapping the location of each zero or
4 more acceptable product locations transferred from each respective one or more transport
5 structures providing product to the second transport structure into said data structure.

1 49. The program storage device readable by a machine as claimed in Claim 48, wherein
2 said step b) of transferring one or more pluralities of products from said one or more

3 transport structures to a second transport structure includes buffering a plurality of first
4 transport structures at a buffer location prior to said transfer.

1 50. The program storage device readable by a machine as claimed in Claim 47, wherein
2 said product is an ophthalmic lens, said second transport structure comprising a hydration
3 tray means for carrying acceptable lens products from one or more first transport
4 structures to a hydration station for simultaneously hydrating said formed lenses.

1 51. The program storage device readable by a machine as claimed in Claim 45, wherein
2 said step of staging a plurality of individual transport structures each capable of receiving
3 an individual product to be transferred from said first transport structure comprises the
4 steps of:
5
6 feeding a plurality of individual transport structures to a first location via a first conveyor
7 in accordance with said received bit pattern;
8
9 transporting zero or more individual transport structures to said staging area via a second
10 conveyor in accordance with a received bit pattern;
11
12 one of engaging an individual transport structure in response to detection of a first bit
13 value from said bit pattern, or preventing engagement of an individual transport structure
14 in response to detection of a second bit value from said bit pattern; and respectively in
15 response,
16
17 handing-off an engaged individual transport structure to a second conveyor for indexed
18 conveyance to said staging area in accordance with a first bit value of said bit pattern or
19 is prevented from handing-off said individual transport structure to said second conveyor
20 in accordance with a second bit value of said bit pattern; and,

21 enabling indexed movement of said second conveyor in accordance with an amount of
22 said pre-defined number of bits in said bit pattern, whereby handed-off individual
23 transport structures are conveyed to said staging area and registered at locations
24 corresponding to received first bit values of said pre-defined number of bits.

1 52. The program storage device readable by a machine as claimed in Claim 51, wherein
2 said staging area includes a product load position where said acceptable products are
3 simultaneously transferred thereto from a product unload location, said method steps
4 further comprising the step of simultaneously pushing said individual transport structures
5 to said product load position after registered in accordance with said bit pattern.

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